PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

B48

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3 : G02F 1/19

A1

(11) International Publication Number: WO 82/ 02961

(43) International Publication Date: 2 September 1982 (02.09.82)

(21) International Application Number: PCT/GB82/00059

(22) International Filing Date: 23 February 1982 (23.02.82)

(31) Priority Application Number: 8105802

(32) Priority Date: 24 February 1981 (24.02.81)

(33) Priority Country: GB

(71) Applicant *(for all designated States except US)*: S.A. PATSCENTRE BENELUX N.V. [BE/BE]; 11 Avenue Albert Einstein, B-1348 Louvain La Neuve (BE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: BASSETT, Peter, John [GB/BE]; 39 Rue J.B. Colyn, Bte 17, B-1050 Brussels (BE). VERHEIJEN, Augustine, Wilhelmus [DK/BE]; Rue Blanche 38 BP45, B-1050 Brussels (BE). PEETERS, Josephus, Bonifacius [BE/BE]; Haachustraat 136A, B-3008 Veltem Beisem (BE).

(74) Agents: CRAWFORD, Andrew, Birkby et al.; A.A. Thornton & Co., Northumberland House, 303-306 High Holborn, London, WC1V 7LE (GB).

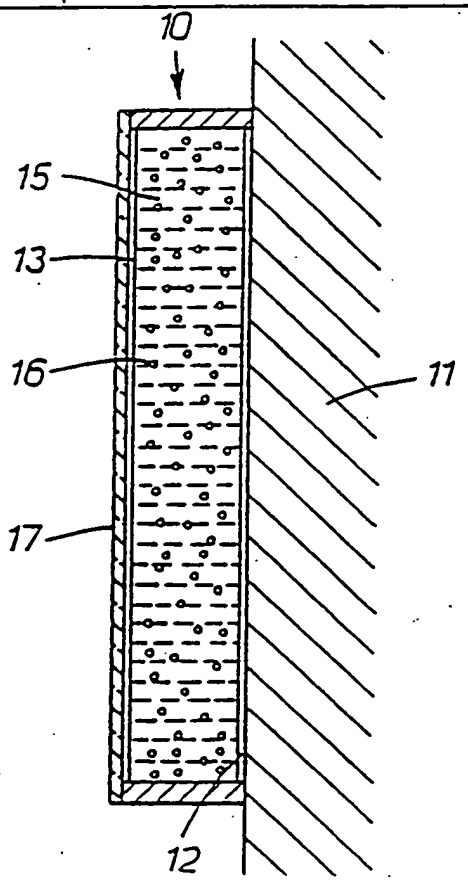
(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.

(54) Title: DISPLAY DEVICE

(57) Abstract

An electrophoretic display device utilizes transparent spheres (16) whose diameter is similar to that of visible light in place of the conventional pigment particles whereby to enhance the retro-reflective effect of the device. The spheres (16) may be glass or plastics or a combination of both with a specific gravity similar to that of the suspension medium (15) in which they are contained.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	KP	Democratic People's Republic of Korea
AU	Australia	LI	Liechtenstein
BE	Belgium	LK	Sri Lanka
BR	Brazil	LU	Luxembourg
CF	Central African Republic	MC	Monaco
CG	Congo	MG	Madagascar
CH	Switzerland	MW	Malawi
CM	Cameroon	NL	Netherlands
DE	Germany, Federal Republic of	NO	Norway
DK	Denmark	RO	Romania
FI	Finland	SE	Sweden
FR	France	SN	Senegal
GA	Gabon	SU	Soviet Union
GB	United Kingdom	TD	Chad
HU	Hungary	TG	Togo
JP	Japan	US	United States of America

DISPLAY DEVICE

The present invention relates to display devices and more particularly to electrophoretic or dielectricphoretic display devices.

Electrophoretic display devices are known and a feature of these devices is that they are passive, i.e. they do not emit light rather they reflect or transmit incident light.

An object of the present invention is to provide an electrophorectic or dielectricphoretic display device with enhanced reflectance in the direction of illumination.

In order that the present invention be more readily understood, an embodiment thereof will now be described by way of example with reference to the accompanying drawing which shows a cross-section through an electrophoretic display device.

An electrophoretic display device 10 comprises a non-conductive substrate 11 to which is applied an electrode 12 and an electrode 13 spaced from the electrode 12. The space between the electrode 12 and the electrode 13 is filled by a liquid material 15 containing small particles 16. When an electric field is applied across the space by a voltage applied to the electrode 12 and electrode 13, the particles migrate to either the electrode 12 or the electrode 13. Either or

both of the electrodes 12, 13 can be an array so as to produce any desired pattern depending on the disposition and shape of the or each array.

In this embodiment, the device is designed for viewing in the direction of the arrow A in which case the electrode 13 will be formed of a transparent material and provided with a transparent protective cover 17.

The particles 16 are specifically selected for their reflective properties and it has been found that they should be optically transparent in at least part of the visible spectrum. Further, they should have a diameter similar to or larger than the wavelength of visible light, e.g. from 0.5 to 20 microns. It is advantageous if they have a specific gravity similar to that of the liquid material so that they exhibit neutral buoyancy in the liquid material and can move relatively easily under the action of an electric field.

These two desiderata point to glass or plastics particles being used. A combination of glass and plastics is also possible such as glass coated with plastics. The preferred plastics are polyamide, polyimide, polyester, polypropylene or polycarbonate.

Preferably the particles are spherical but may be either solid or hollow spheres. The refractive index of the material of the spheres should preferably be higher than that of the liquid material. Such particles are known to exhibit good reflectance in the direction of illumination.

The electrophoretic activity can be enhanced by adding a surfactant to the liquid material and/or by forming electrets within the particles.

The above construction may be used as an addressable sign such as a road sign, a warning display or an information panel and has the additional advantages that dye absorption on reflective glass particles would

be lower than absorption on conventional organic pigments. This provides increased perceived contrast. Also, chemical and light-induced degradation is lower for glass particles than for organic pigments. Thus, the life of the device would be increased.

With glass particles, it may be necessary to process them so that they exhibit an electrophoretic effect. A number of processes are available such as exposing molten glass to an electrical discharge and cooling the glass to trap charged particles in the glass matrix. Alternatively, glass at room temperature could be exposed to ionizing radiation such as cathode rays or X-rays to form charged particles in the glass. Both these processes form electrets but it is also possible to activate the surface of the glass particles chemically and then coat the particles with long chain molecules to cause a charge to be present.

CLAIMS:

1. A display device comprising spaced electrodes and electrophoretically active particles in a liquid suspension medium disposed between said electrodes, the particles having a refractive index greater than that of the suspension medium characterised in that the particles are transparent to light in at least part of the visible spectrum and have an external diameter similar to or larger than the wavelength of visible light.

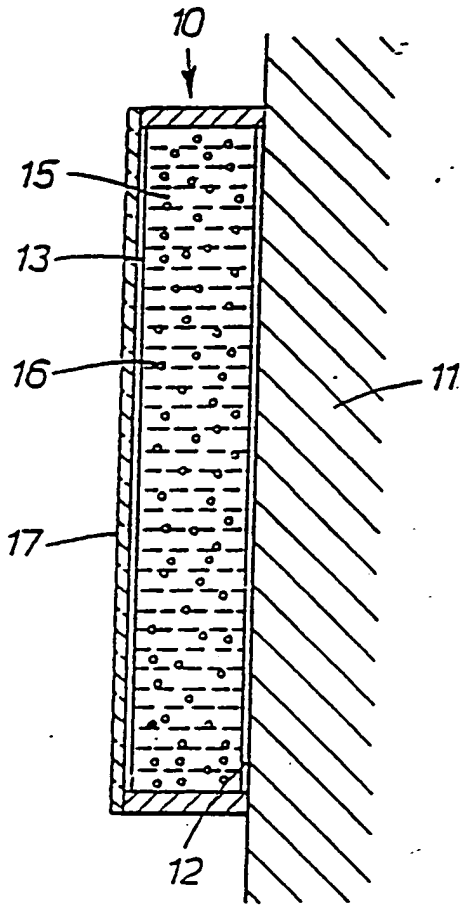
2. A display device according to claim 1, characterised in that the particles are spheres and are of glass or plastics materials or a combination thereof.

3. A display device according to claim 1 or 2, characterised in that the particles are hollow.

4. A display device according to claim 1, 2 or 3, characterised in that the particles have a specific gravity similar to that of the suspension medium.

5. A display device according to any one of the preceding claims characterised in that the particles include electrets to enhance the electrophoretic activity.

6. A display device according to any one of the preceding claims, characterised in that the liquid suspension medium includes a surfactant to enhance the electrophoretic activity.


10
15
13
16
11
17
12

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No 18
	"Developments in electrophoretic displays", see pages 243-254, in particular page 244, paragraph B and page 245, paragraph III	1,6
A	US, A, 2792752 (A.J. MONCRIEFF-YEATES et al.) May 21, 1957, see column 4, line 24 and claim 1	1,2
A	US, A, 3972715 (K. OKUMURA) August 3, 1976, see column 6, lines 18-20 and claim 1	5
A	Optics Communications, volume 15, no. 2, October 1975 (Amsterdam, NL) T. Yoshimura et al. "The spectral profile of light scattered by particles in electrophoretic movement", see pages 277-280	2
A	GB, A, 1442360 (SECRETARY OF STATE FOR DEFENCE) July 14, 1976	1,2
A	US, A, 3169163 (H. Nassenstein) February 9, 1965	1
A	US, A, 3782932 (V. TULAGIN) January 1, 1974	1

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 82/00059

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[3]: G 02 F 1/19

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC[3]	G 02 F 1/19; G 03 G 17/04

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [6]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 3954465 (J.B. WELLS et al.) May 4, 1976, see column 2, lines 50-51; column 3, lines 50-51; column 4, lines 15-18	1,2,4
Y	EP, A1, 0023741 (PHILIPS) February 11, 1981, see page 2, line 32 - page 3, line 21; page 10, lines 18-27	1
Y	US, A, 4126528 (A. CHIANG) November 21, 1978, see column 1, line 34 - column 2, line 35	1,2,4
A		3
Y	L'Onde Electrique, volume 59, no. 10, October 1979 (Paris, FR) J.L. Ploix et al "Afficheurs par électrophorèse" see pages 65-69, in particular page 66, right-hand column	1
A	see paragraph III	4,6
A	Proceedings of the SID, volume 18, no. 3/4, 1977 (Los Angeles, US) I. Ota et al. ./.	

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [1]	Date of Mailing of this International Search Report [1]
May 18, 1982	June 10, 1982
International Searching Authority [1]	Signature of Authorized Officer [20]